between the first SAS expander and the port of the device, re-routing the data transfer of the first SAS expander 202a to a second SAS expander 202b. For example, the data transfer may be re-routed from the first SAS expander 202a to a second SAS expander 202b via an IEL path connecting at least one phy for the first SAS expander for inter-expander communications to at least one phys of the second SAS expander for inter-expander communications.

In a fourth step 1308, the method 1300 for back-off retry includes determining link availability between the second SAS expander 202b and the port (e.g., output port 510) of the device. As previously described above, the second SAS expander 202b may indicate phy blocking by sending a vendor unique status "SAS PRIMITIVE" back to the first SAS expander 202a. Then, the first SAS expander 202a may receive the SAS PRIMITIVE status from the second SAS expander 202b.

In a fifth step 1310, the method 1300 for back-off retry includes, upon determination of a failed link or a busy link between the second SAS expander and the port of the device, re-routing the data transfer from the second SAS expander 202b to the first SAS expander 202a or to a third SAS expander (e.g., 202c or 202d), or retrying the data transfer through the second SAS expander 202b. For example, upon receiving the blocked connection SAS PRIMITIVE status from the second expander 202b, the first SAS expander 202b may re-route the data transfer to another SAS expander (e.g., first SAS expander 202a or a third SAS expander, such as 202c or 202d). This process may be repeated until a phy on one of the SAS expanders becomes available, allowing the first connection to complete on either of the expanders to be used to complete the connection to the destination port (e.g., output port 510).

In the present disclosure, the methods disclosed may be implemented as sets of instructions or software readable by a device. Such software may a computer program product which employs a computer-readable storage medium including stored computer code which is used to program a computer to perform the disclosed function and process of the present invention. The computer-readable medium may include, but is not limited to, any type of conventional floppy disk, optical disk, CD-ROM, magnetic disk, hard disk drive, magneto-optical disk, ROM, RAM, EPROM, EEPROM, magnetic or optical card, or any other suitable media for storing electronic instructions. Further, it is understood that the specific order or hierarchy of steps in the methods disclosed are examples of exemplary approaches. Based upon design preferences, it is understood that the specific order or hierarchy of steps in the method can be rearranged while remaining within the disclosed subject matter. The accompanying method claims present elements of the various steps in a sample order, and are not necessarily meant to be limited to the specific order or hierarchy presented.

It is believed that the present disclosure and many of its attendant advantages will be understood by the foregoing description, and it will be apparent that various changes may be made in the form, construction and arrangement of the components without departing from the disclosed subject matter or without sacrificing all of its material advantages. The form described is merely explanatory, and it is the intention of the following claims to encompass and include such changes.

What is claimed is:

1. A method for back-off retry in a single, cohesive serial attached small computer system interface (SAS) expander, comprising:

routing a data transfer between an input of a single, cohesive SAS expander and an output of the single, cohesive SAS expander, wherein the single, cohesive expander includes a first SAS expander, and at least one additional SAS expander, wherein the first SAS expander is connected to the at least one additional SAS expander via at least one inter-expander link (IEL) for inter-expander communications,

wherein the routing the data transfer further includes:

routing a first OPEN request on a direct path through the first SAS expander to a port of a device; and

routing a second OPEN request on an indirect alternate path from the first SAS expander and through a second SAS expander to the port of the device, the indirect alternate path established via an IEL connecting at least one phys of the first SAS expander for inter-expander communications to at least one phys of the second SAS expander for inter-expander communications;

determining link availability between the second SAS expander and the port of the device; and

upon determining the link availability between the second SAS expander and the port of the device to be a failed link or a busy link:

re-routing the data transfer from the second SAS expander to the first SAS expander when the first SAS expander is available;

re-routing the data transfer from the second SAS expander to the third SAS expander when first SAS expander is not available; and

retrying the data transfer through the second SAS expander when the first SAS expander and third SAS expander is not available.

2. The method of claim 1, wherein the IEL between the first SAS expander and the at least one additional SAS expander connects the first SAS expander to the at least one additional SAS expander via at least one phy for inter-expander communications of the first SAS expander and at least one phy for inter-expander communications of the at least one additional SAS expander.

3. The method of claim 1, further comprising:

sending a vendor unique status SAS PRIMITIVE from the second SAS expander to the first SAS expander upon determination that the second SAS is unable to complete the data transfer to the port of the device.

4. The method of claim 1, wherein the determining link availability between the second SAS expander and the port of the device comprises:

receiving an SAS PRIMITIVE status sent by the second SAS expander, the SAS PRIMITIVE status received by the first SAS expander.

5. The method of claim 1, wherein at least one of the failed link or the busy link results from at least one of a physical malfunction or a logical malfunction.

6. The method of claim 1, wherein the re-routing the data transfer from the second SAS expander to the first SAS expander or a third SAS expander comprises:

re-routing the data transfer from the second SAS expander to the first SAS expander via an IEL path connecting at least one phys of the first SAS expander for inter-expander communications to at least one phys of the second SAS expander for inter-expander communications or re-routing the data transfer from the second SAS expander to a third SAS expander via an IEL path connecting at least one phys of the second SAS expander for